Open Systems
Joint Task Force

This document is published as a working draft to solicit your comments and suggestions. We invite your comments on the content and your recommendations on additional information that would aid program managers as they implement an open systems approach to weapon systems acquisition

An Open Systems Approach to Weapon System Acquisition

Directory

Fielding affordable combat capability

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Executive Summary

An Open System Approach (OSA) is a means to assess and implement when feasible, widely supported commercial interface standards in developing systems using modular design concepts. It is a significant part of the toolset that will help meet DoD's goals of modernizing weapon systems, developing and deploying new systems required for 21st century warfare, and supporting these systems over their total life cycle. DoD 5000 series documents call for an OSA as an integral part of the overall acquisition strategy.

An OSA is an integrated technical and business strategy that defines key system or equipment interfaces by widely used consensus-based standards. The open systems strategy is an enabler to achieve the following objectives:

- *adapt to evolving requirements and threats*
- *promote transition from science and technology into acquisition and deployment*
- *facilitate systems integration*
- *leverage commercial investment*
- *reduce the development cycle time and total life-cycle cost*
- *ensure that the system will be fully interoperable with all the systems which it must interface, without major modification of existing components*
- *enhance commonality and reuse of components among systems*
- *enhance access to cutting edge technologies and products from multiple suppliers*
- *mitigate the risks associated with technology obsolescence*
- *mitigate the risk of a single source of supply over the life of a system*
- *enhance life-cycle supportability*
- *increase competition*

Systems engineering (SE) management is the technical management component of the DoD acquisition management process and consists of three essential integrated activities: development phasing, life cycle integration, and the systems engineering process. The systems engineering process has been and will continue to be a widely accepted practice within industry and DoD. Realizing the benefits of an OSA does not require a wide departure form this widely accepted practice. What it does require is a different mindset as the process is executed during the design of a weapon system and then repeated throughout the life cycle of that system.

The purpose of this guide is to provide program managers, system engineers, contracting officers, and the entire program team the tools required to execute the systems engineering process while following an OSA. If successful, this guide will enable our program teams to realize the benefits of an OSA and meet the goal of fielding superior, affordable combat capability.

An Open Systems Approach

An Open Systems (OS) approach is a means to assess and implement when feasible, widely supported commercial interface standards in developing systems using modular design concepts. It is a significant part of the toolset that will help meet DoD's goals of modernizing weapon systems, developing and deploying new systems required for 21st century warfare, and supporting these systems over their total life cycle.

An OS approach is an enabler that supports program teams in the acquisition community to 1) design for affordable change, 2) employ evolutionary acquisition, and 3) develop an integrated roadmap for a weapon system. This approach supports achieving the following:

- *reduced acquisition cycle time and overall life-cycle cost*
- *ability to insert cutting edge technology as it evolves*
- *commonality and reuse of components among systems*
- *increased ability to leverage commercial investment*

The evolutionary acquisition concept provides a defined capability with a roadmap for increased capability to meet evolving requirements and threats. An integrated roadmap is a tool for detailing the strategy to deliver a weapon system that is capable, affordable, and supportable throughout its planned life cycle. Designing a system for affordable change requires modularity.

An Open Systems Approach is *an integrated business and technical strategy that employs a modular design and, where appropriate, defines key interfaces using widely supported, consensus-based standards that are published and maintained by a recognized industrial standards organization.*

"The foundation of an OSA is a modular design"

Partitioning a system appropriately during the design process to isolate functionality makes the system easier to develop, maintain, and modify or upgrade. Given a system designed for modularity, functions that change rapidly or evolve over time can be upgraded and changed with minor impact to the remainder of the system. This occurs when the design process starts with modularity and future evolution as an objective.

Modular designs are characterized by the following:

- Functionally partitioned into discrete scalable, reusable modules consisting of isolated, self-contained functional elements
- Rigorous use of disciplined definition of modular interfaces, to include object oriented descriptions of module functionality

- Designed for ease of change to achieve technology transparency and, to the extent possible, makes use of commonly used industry standards for key interfaces

"Focus on interfaces…"

Interface standards specify the physical, functional, and operational relationships between the various elements (hardware and software), to permit interchangeability, interconnection, compatibility and/or communication. The selection of the appropriate standards for system interfaces should be based on sound market research of available standards and the application of a disciplined systems engineering process.

"Key interfaces…"

Key interfaces are interfaces between modules for which the preferred implementation uses open standards. Open specifications and standards are those that are widely used, consensus based, published and maintained by a recognized industrial standards organization. These interfaces are selected for ease of change based on a detailed understanding of the maintenance concepts, affordability concerns, and where technologies or requirements are intended to evolve. Key interfaces should utilize open standards in order to produce the largest life cycle cost benefits.

Conceptually, key interfaces are illustrated in Figure 1. Interfaces at and above key interfaces are those that should be designated for use of open interface standards. Standards for interfaces below this level may also be open; however, selection is left to the supplier as part of detail design.

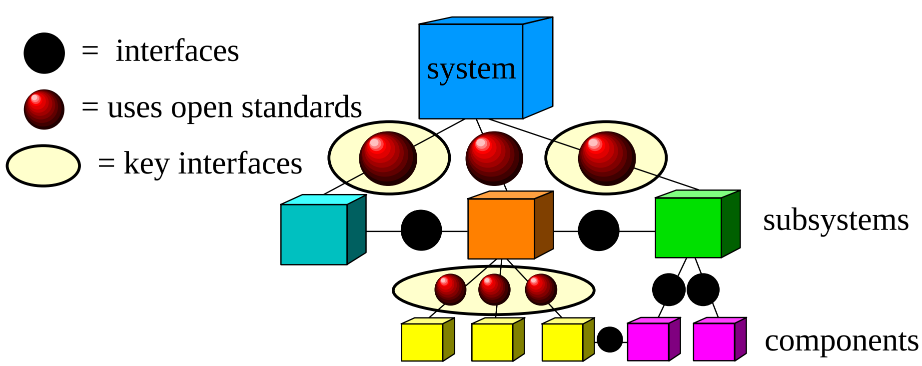


Figure 1: Key Interfaces

"Standards selection"

In order to take full advantage of modularity in design, interface standards must be well defined, mature, widely used, and readily available. Figure 2 depicts different types of interface standards. In general, popular open standards yield the most benefit to the customer in terms of ease of future changes to the system and should be the standards of choice. However, there are situations where proprietary standards are the correct choice.

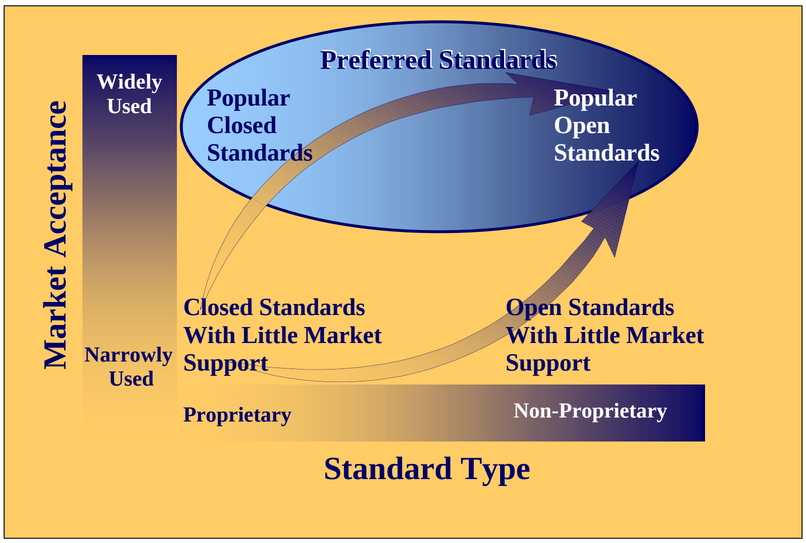


Figure 2 Standards Selection

Standards should be selected based on maturity, market acceptance, and allowance for future technology insertion. As part of the open systems approach, preference is given to the use of open interface standards first, the de facto interface standards, and finally government and proprietary interface standards.

Open standards allow programs to leverage commercially funded or developed technologies and to take advantage of increased competition. They also allow faster upgrade of systems with less complexity and cost. Bottom line, systems can be fielded that are more affordable.

"Open Systems Policy…"

The DoD 5000 series documents require program managers to use an open systems approach in the development of systems. DoDD 5000.1, approved 23 October 2000, states in paragraph 4.3.1 that:

"To facilitate evolutionary acquisition, program managers shall use appropriate enabling tools, including a modular open systems approach to ensure access to the latest technologies and products, and facilitate affordable and supportable modernization of fielded assets."

DOD 5000.2-R, approved 10 June 2001, requires program managers to, *"apply the open systems approach as an integrated business and technical strategy upon defining user needs."* Further, it states that *"PMs shall assess the feasibility of using widely-supported commercial interface standards in developing systems"* and that *"The open systems approach shall be an integral part of the overall acquisition strategy."* PMs are required to *"document their approach for using open systems and include a summary of their approach as part of their overall acquisition strategy."*

PMs are also required to *"identify key interfaces and define the system level (system-of-systems, system, subsystem or component) at and above which these interfaces use various types of standards. Preference shall be given to the use of open interface standards first, then de facto interface standards, and finally government and proprietary interface standards. PMs shall report on their progress using open standards for key interfaces at both Milestones B and C."*

As program teams analyze requirements, they can consider the advantages of a modular design and selecting open interface standards for a set of modules and interfaces appropriate for their particular acquisition. In doing so, they are in fact using an open systems approach. Employing an OS approach at the early stages of an acquisition or modification allows program teams to document their approach and strategy for meeting their objectives in their acquisition documents, such as their acquisition strategy, statement of objectives (SOO) and request for proposal (RFP), including proposal evaluation criteria.

The benefits of following an OS approach can be realized in every phase of the acquisition process and should be revisited throughout the life of the system. As acquisition programs progress and as current systems need upgrade, an OS approach helps optimize affordability of systems. The next section details the application of these concepts and policies within a generic systems engineering framework.

Implementing an Open Systems Approach

Getting started

An Open Systems (OS) approach is both a business and engineering strategy for developing a new system or modernizing an existing one. As a business strategy, the OS approach enables program teams to build, upgrade and support systems more quickly and affordably. This can be achieved through the use of commercial products from multiple sources and leveraging the commercial sector investment in new technology and products. The technical portion of the OS approach is focused on a system design that is modular, has well defined interfaces, is designed for change and, to the extent possible, makes use of commonly used industry standards for key interfaces. This system design is best accomplished using a sound systems engineering processes.

Systems Engineering Management

Effective implementation of an OS approach is largely determined by the degree to which it is an integral part of a sound systems engineering (SE) management process. SE management is accomplished by integrating three major activities:

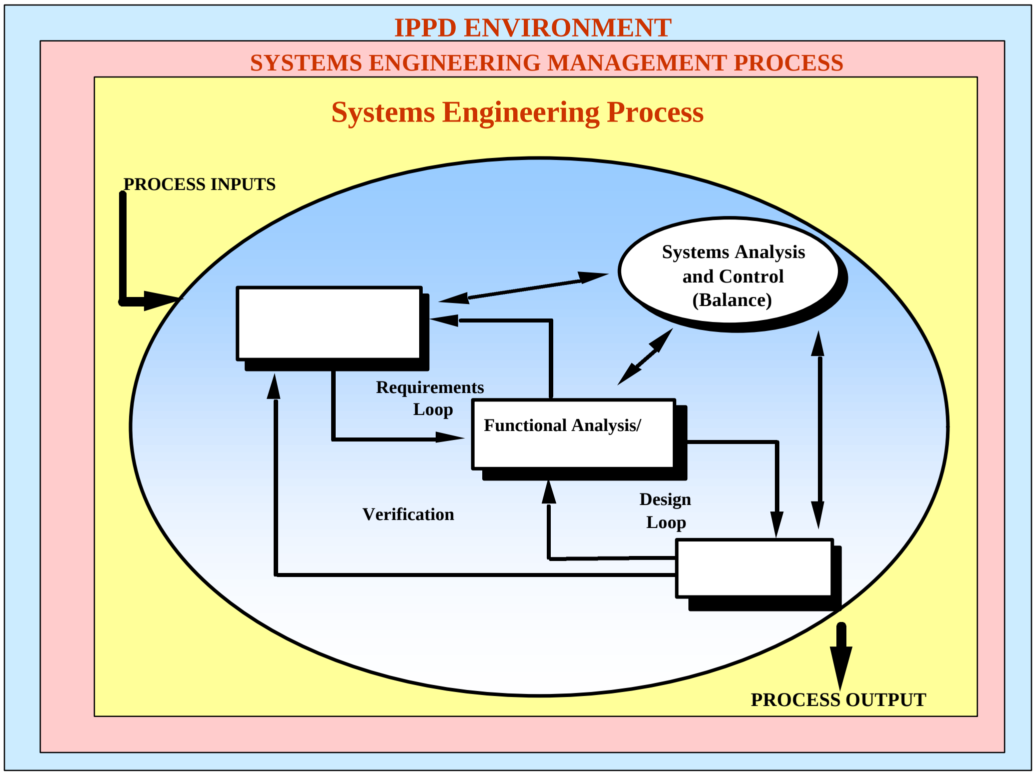
- **Development phasing.** Modern, complex systems typically develop and mature through a process involving movement through several distinct phases. Movement from one phase to the next brings together the technical and overall acquisition management efforts, controls the design process, and provides the baseline needed for coordinating design efforts.
- **Life cycle integration**. This activity ensures concurrent consideration of all life cycle needs of a system during the development process. Such consideration is facilitated by the use of Integrated Process and Product Development (IPPD) teams.

Systems engineering process

The SE process is a top-down, comprehensive, iterative, and recursive problem solving process. A typical SE process consists of three fundamental SE activities: Requirements Analysis, Functional Analysis and Allocation, and Design Synthesis along with an overall Systems Analysis and Control function. The relationships between these activities are illustrated in Figure 1 within the context of the overall Systems Engineering Management Process and the IPPD Environment.

Integrated Product and Process Development (IPPD)

The preferred strategy for implementing an open system approach is to employ an Integrated Product and Process Development (IPPD) team comprised of government and industry representatives. The IPPD team must include all of the stakeholders involved in the acquisition and employment of the product. The actual make up of an IPPD team is the responsibility of the program manager. At a minimum, an IPPD team should include those who design, specify, build, test, operate and maintain the system. The responsibilities of the IPPD team include gathering and analyzing previous lessons learned on OS and conducting continuing market research and analysis.



The Systems Engineering Process

This guide will identify and discuss the OS considerations at each of the three fundamental activities in an SE process, Requirements Analysis, Functional Analysis/Allocation, and Synthesis. In addition we will briefly discuss the set of inputs and outputs of the process. The System Analysis and Control (Balance) is fundamentally the same and is not impacted by inclusion of open system considerations in the overall process. We recommend incorporating an OS approach into the SE process because it is during this process that OS concepts have the greatest impact on the systems design and therefore the greatest benefit to our customers.

Process Input

- Requirements
  - Functional
  - Performance
  - Design
  - Cost
  - Derived
- Constraints
  - Environment
  - Technology
  - Laws & Policies
- Acquisition Strategy
  - Summary of OS approach

The SE process is driven and bounded by the above input. OS considerations (as input) either may be explicitly stated or derived from these input. Open system considerations could be stated as business requirements (e.g., need for continual access to latest technologies from multiple sources), design requirements (e.g., need for robust and scalable architecture with plug and play capability), or as performance requirements (e.g., executing a function with state of the art technology). However, in most cases, the OS considerations are derived from requirements such as system capability to meet evolving threats, or incremental system upgrade without major redesign, which may result in design requirement for a robust and modular architecture with plug and play capabilities.

Program Teams define performance specifications for a product in terms of functions, performance and interface requirements. The supplier is then provided the flexibility to decide how the requirements are best achieved, subject to the constraints imposed by the government. Whatever the nature of open system considerations may be, the program team must always be aware of the benefits and risks associated with implementing a modular OS design strategy.

There will be times when following an OS approach is not the best thing to do. Some environments may require unique and customized products that may preclude the use of open standards. Certain types of operational/performance requirements or system acquisition strategies lend themselves more effectively to the application of an OS approach. If your system has some of the following requirements or characteristics, you should carefully consider following an OS approach during the systems engineering process in your acquisition:

- Time-phased requirements, evolutionary acquisition, or operational requirements specified in an incremental manner over time.
- Requirements that place great emphasis on long-term sustainment and affordability, or establish affordability as the basis for fostering greater program

stability. For example, cost-effective commonality of hardware, software, and support systems to simplify sustainment, and reduce the total cost of ownership are some possibilities.

- The ability to constitute and readily integrate functionally compatible forces and systems. Quick reconfiguration of forces and systems is greatly facilitated by modular architectures and interface standards.
- Digitized battlefield, or heavy reliance on digitized battlefield conditions to create operational capabilities.
- Receiving and disseminating command and control data in real time
- Seamless, high speed, digital information exchange among diverse warfighting elements. Such requirements demand joint and combined/coalition operations over multiple and diverse hardware and software components and communication networks.
- Overarching capabilities for a mission area that form a system of systems or family of systems. When similar open interface standards are applied across a family of weapons systems or a product line, commonality and reuse of components are possible facilitating interoperability.
- Reprogramming of software modules and communication networks where software reuse and increased flexibility is required.
- Integrated and modular communications and navigation capability.
- Application of an integrated approach for adding and facilitating the incorporation of future capabilities and advanced technologies with minimum impact on existing systems.
- Requirements that are defined in terms that enable and encourage offerors to supply commercial and non-developmental item equipment and call for minimizing the risks associated with being captive to specific products or sources.
- Future growth capabilities and performance characteristics that will be highly dependent on continuous use of emerging technologies in computer, communication, surveillance, and navigation technologies.
- Interoperable joint service solutions and development of architectures that must comply with open standards across different platforms.

Requirements Analysis

Requirement analysis is an iterative process and is focused on defining and developing functional and performance requirements, and clarifying constraints that limit design flexibility at each level of development. It is during requirement analysis that the program team can begin to lay the groundwork for future flexibility. As part of the analysis, the team can look at isolating functionality that they expect to change or will need upgrade in the future. The team can also look for opportunities for taking advantage of what the commercial market has to offer. It is also important to begin looking at interfaces, both internal and external to the system. All of these analyses lay the groundwork for an open systems approach.

The development process usually progresses through concept, system, and subsystem/component levels and the development team applies the SE process tasks to each level or stage of system development to establish configuration baselines. Such baselines can assure that the requirements at different levels are balanced, and the benefits and risks associated with application of an OS approach are considered. Moreover, in the process of refining requirements, the development team should avoid early commitments to system-specific solutions, including those that inhibit future insertion of new technology and commercial or non-developmental items.

The primary purpose of the SE process is to transform requirements into designs within the limits of imposing constraints. As part of requirements analysis the study team should identify internal (e.g., program, Component, DoD, etc) and external constraints. Laws and regulations calling for use of commercial standards, the compliance requirements contained in open standards, capabilities of allied or coalition forces that will interface with the system, and the present and future technology base are among external constraints related to open systems. Components' and the DoD guidelines that call for use of an OS approach, domain technologies that necessitates commonality and reuse across platforms, and the system of systems interoperability requirements are among the internal open system related constraints. For a legacy system, there may be previously approved interface specifications and baselines that impose limitations on the upgrade requirements.

The utilization environment of a system also has some open system implications. The physical environment may necessitate modification of commercial products because they may not withstand the humidity, temperature, vibration, and electromagnetic environments in a weapon system. Long term supportability and maintainability may also be impacted if unique proprietary interface standards are employed in the system resulting in dependency on a sole source and possibly costly maintenance for the life of a system. The size and weight of products in the system under development may impose restrictions on use of commercial interface standards and products. The physical characteristics would potentially pose greater difficulties for the large number of mechanical and electronic devices employed in tiny spaces in modern weapons systems.

Another important constraint that affects requirements analysis is the need for external interfaces. This is perhaps the biggest task concerning open system implications and considerations. It requires the identification of system of systems interoperability requirements, and need for commonality of hardware or software reuse among systems and platforms.

During requirements analysis the program team continues to develop and refine their acquisition strategy. Listed below are some items that are key OS approach acquisition strategy considerations that can be beneficial to discuss during requirements analysis. They are formed as questions.

Does the program have plans in place for:

- Evolving the system over its lifetime?
- Capitalizing on commercial technology?
- Controlling total ownership cost and reducing acquisition time?
- Enhancing long-term supportability?
- Achieving interoperability?
- Taking advantage of competition?

Functional Analysis/Allocation

The purpose of Functional Analysis/Allocation is to transform requirements identified during requirements analysis into a coherent description of system functions. The first step is to partition the system into modular functions. The process then proceeds to decomposing higher-level functions into lower-level functions, identifying interfaces (e.g., internal and external,), and finally to allocating performance from higher to lower-level functions. This process is repeated to define successively lower level functional and performance requirements, thus defining architectures at ever-increasing levels of detail.

When following an OS approach during this portion of the SE process, the items listed below key ingredients that allow you to realize the long-term benefits of a modular design and open interface standards.

- Partition system into modules
- Allocate performance/requirements to functional modules
- Perform Trade-offs
- Define interface between modules with a Technical Reference Model
- Identify key interfaces and assess feasibility of making them open
- Develop a modular standards based architecture

System Partitioning

Based on DoD 5000.2-R, "iterative requirements analyses must accompany functional analysis/allocation to develop and refine system-level functional and performance requirements and external interfaces to facilitate the design of open systems." Iterative functional analyses/allocations should also define "successively lower-level functional and performance requirements, including functional interfaces and architecture to achieve open systems and facilitate the use of a performance-based business environment."

In partitioning the system into functions pay special attention to group functionality into self-contained and cohesive modules. It is also important to pay special attention to the rate of change of technologies utilized in a module. Group functions that use rapidly changing technologies together so that you have the opportunity to define the interfaces to these modules using open standards. This will increase your options later and make changing/upgrading them easier in the future. Another approach could be to group functions together that may have a high failure/replacement rate in order to decrease support costs or lay the ground work for a later product improvement During this part of the process, you may be able to learn the best way to group functionality by performing trade-off analyses to help you decide what is best for your particular system.

In the case of an existing system, the program team's efforts in this part of the SE process also include gathering information on the AS-IS architecture and performing the essential mapping of services and interfaces to known functions and capabilities. Knowledge of the other respective systems/subsystems that must be interfaced should be also derived from the existing operational requirement documents. Review the design specifications, interface control documents, functional specifications, and known standards profiles for an existing system to assess the appropriateness of implementing open standards where possible.

By partitioning a system into modules you will be able to develop a flexible system, reduce program risk, ensure operational supportability, design for producibility, ensure affordability, and demonstrate system integration, interoperability, and utility.

Using a Technical Reference Model

A technical reference model (TRM) provides a high level, generalized system view of the weapon system family. Generally speaking, a TRM:

- Is a common high-level communications vehicle for system stakeholders. It embodies the earliest set of design decisions about the system. These decisions are the most difficult to get right, the hardest ones to change and have the most far-reaching effects downstream.
- Forms the organizational plan for development of an open system. It establishes a context for understanding how disparate technologies and standards relate to each other. Done well, a reference model is a high-level vehicle for incorporating existing or planned components.
- Provides a framework for breaking out the system and applying standards. Well-formed reference models exhibit modularity. The reference model provides a framework for how to apply standards, particularly, how to identify interfaces that are key to achieving system technical and business goals.

A TRM can support functional partitioning and modular design of the system. It can be used as a tool to promote common understanding of the system design and interfaces by the stakeholders. Also the TRM can be to identify those interfaces that have significant impact on the total ownership cost or on adding new capabilities and technologies for example. These and the other reasons for isolating functionality discussed earlier are the basis for determining which of these interfaces are the key interfaces. We will discuss key interfaces in the next section.

Figure 2 is an example of how a reference model might depict the functional parts comprising systems belonging to an aircraft design. It demonstrates decomposition of the overall weapon system's mission into a smaller number of simpler functional building blocks. Each functional building block can be similarly decomposed. The selection of particular functional entities represents the initial design decisions for how the weapon system will be engineered. Here, modularity in design is facilitated by aligning functional partitioning with physical modularity where modularity is used to facilitate the replacement of specific subsystems and components without impacting other parts of the system. The boundary or interface between each building block pair is defined by the services provided over that interface. Reference models provide a high-level view of the system modularity and the interfaces between those modules.

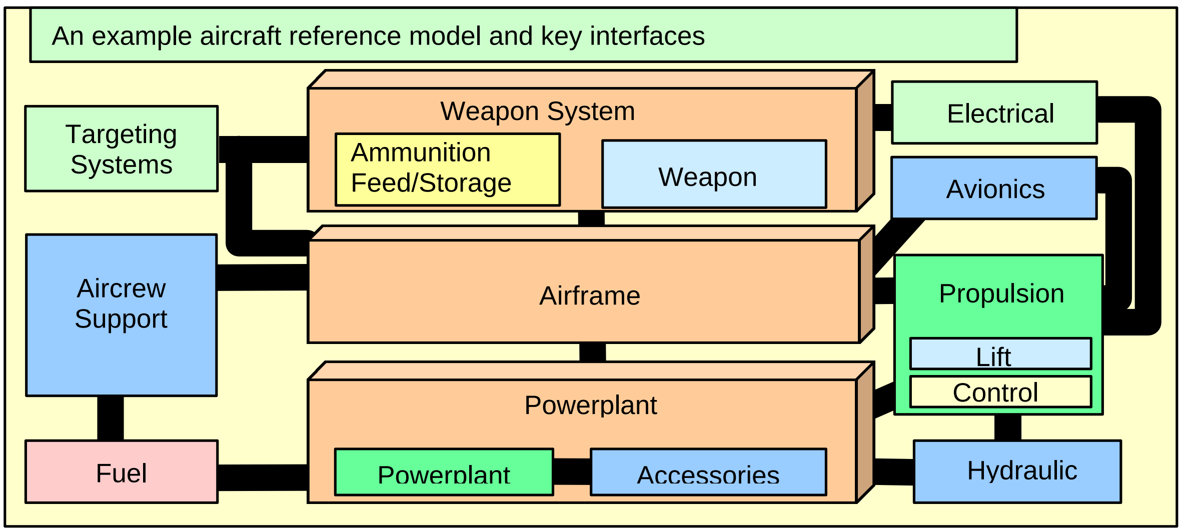


Figure 2 An Aircraft Reference Model

Key Interfaces

Key interfaces include interfaces where the technology turnover is rapid on one or both sides of the interface, design risk is high on either side of the interface, and the system elements on one or both sides of the interface exhibit a high failure rate or are very expensive. Interfaces between modules with one or more of the following characteristics are good candidates to designate as key interfaces:

Evolving requirements
New/additional capabilities envisioned
Incremental improvements through planned upgrade
Rapidly changing technology
High replacement frequency/cost
Need for commonality and interoperability

Interfaces may be controlled through interface management. Interface management identifies, develops, and maintains the external and internal interfaces necessary for system operations. It also ensures that system elements are compatible in terms of form, fit, and function. Interface management may also include establishing an Interface Control Working Group, which among other things may establish the Interface Control Documentation.

Factors that may be considered by the program team as they decide whether or not they should use open standards to define a key interface:

- Overall acquisition strategy (e.g., the likelihood that the technologies/engineering for full capability still need to be developed and whether or not the longer-term requirements are stable or addressed as evolving increments.)
- The degree of dependency on rapidly evolving technology and the technology readiness level for the components or items at both ends of an interface
- The intensity and magnitude of risks associated to a proprietary interface standard
- Need for minimizing integration risks over the life of the system
- Need to take advantage of competition throughout the life cycle
- Need for design flexibility, modularity, and interface control
- Availability, maturity, verification, and accreditation of standards for an interface
- Support strategy (e.g., the extent of market acceptance and availability of products that comply with a selected standard)

Standards-Based Architecture

Once complete, the above tasks will result in the development of a standards based architecture for the system. A standards based architecture is one that is defined to provide for expansion or functional reconfiguration through incorporation of replaceable modules. An example of standards based architecture is the desktop computer in which the hardware and software can be configured as a word processor or a graphics processor depending on the software programs available. A new plug in board such as a modem can be installed with minimal integration. All aspects of the system interfaces are so well defined that independent designers of subsystems or modules can do their work without close coordination with each other. Under the ideal situation, a product can be installed/replaced in an open architecture with minimal integration.

Synthesis

Design synthesis translates functional and performance requirements into design solutions that include alternative people, product, and process concepts and solutions, and internal and external interfaces. The following set of activities are performed during synthesis:

- Transform functional to design architecture
- Define alternative system concept, configuration items, and system elements

- Select preferred standards and products
- Define/redefine the interfaces

Transform functional to design architecture.

Use modularity principles (maximal cohesiveness of the functions and minimal coupling among elements) to convert functional to design architectures. Group and regroup components that perform a single independent function or single logical task into modules. Use desirable attributes such as low coupling, high binding (cohesion), and low connectivity to do the grouping required for modularity. Decoupling modules eases development risks and makes future modifications easier. High binding (similarity of tasks performed within the modules) allows for use of identical or like components or for use of a single component to perform multiple functions. Low connectivity (relationship among internal elements of one module to those of another module) is desirable because it reduces design and test complexity.

Define alternative system concept

Include open versus closed interface considerations in performing trade studies to compare the alternative system concepts and the candidate hardware and software architectures. Challenge the trade studies that preclude use of open interface standards and open standards-compliant products. Use the Work Breakdown Structure developed from the design architecture as a reference in identifying and defining key interfaces.

Prototype the system, subsystems, and components to demonstrate the integration of the system using the proposed modular decomposition. Also, use prototypes to demonstrate standards and standards-compliant products. Do not select the final products at this time. Demonstrate that potential interface standards and specifications will achieve required system performance.

Select standards for key interfaces

Once key interfaces are selected, the next task for the program team is to determine whether or not it is feasible to use an open interface standard for each of the key interfaces. In an OS approach, the fact that an interface has been designated as a key interface means that the preferred implementation would employ an open interface standard. This does not mean that the final implementation for every key interface will always use an open standard. There will be times when the best decision is to use a closed interface. This decision is left to the program team as part of the OS approach.

The program team through market research should examine available standards to determine whether or not they are applicable to their particular system. Program teams should continue performing market research to determine if suppliers will continue to produce or support the standards selected, and to identify new products and standards that will replace those in use. Industry standards organizations are excellent sources of information to help you identify candidate interface standards.

Once standards are selected for the key interfaces, the program team also needs to develop a method of verification or conformance to the interface specification itself. It can not be assumed that a product conforms to a stated interface standard. Testing can and should be developed to ensure conformance of selected commercial items and non-developmental items to appropriate interface definitions.

Process Outputs

As you progress through the iterative SE process under an OS approach several items will emerge that will assist you in development of the weapon system. Listed below are the key products that are related to open systems. An OS approach is based on a modular design and the use of open interface standards for key interfaces where feasible. These products will help you document and manage the acquisition following an OS approach.

- Technology Upgrade Plan
- Modular Open Systems Architecture
- Interface Management Plan
- Documented approach for open systems implementation

OS Reporting

DoD 5000 requires program managers to report on their progress in implementing an OS approach to their milestone decision authority. Verify the use of open interfaces and report on the progress of using open standards for key interfaces at Milestone B and C. Remember that the open system design is one of the criteria by which milestone decision authorities decide whether or not commit to low-rate initial production.

OS Contract Language

You may use OS considerations and interface management as considerations in source selection (see Appendix B for examples of contract language). You may incentivize the contractor to follow an OAS approach. Utilize contract-pricing structures, including incentives as appropriate, to obtain from offerors proposals, and from contractors performance, that realizes the full potential of an OS approach.

Open system related outputs of the SE process consist of the documents (e.g., modular open system architecture, key interface specifications, etc.) that define the system requirements and design solutions. The outputs become increasingly detailed as system definition proceeds from concept to detailed design. In summary figure 2 show the traditional systems engineering process and a brief summary of the things to consider as you follow an OS approach.

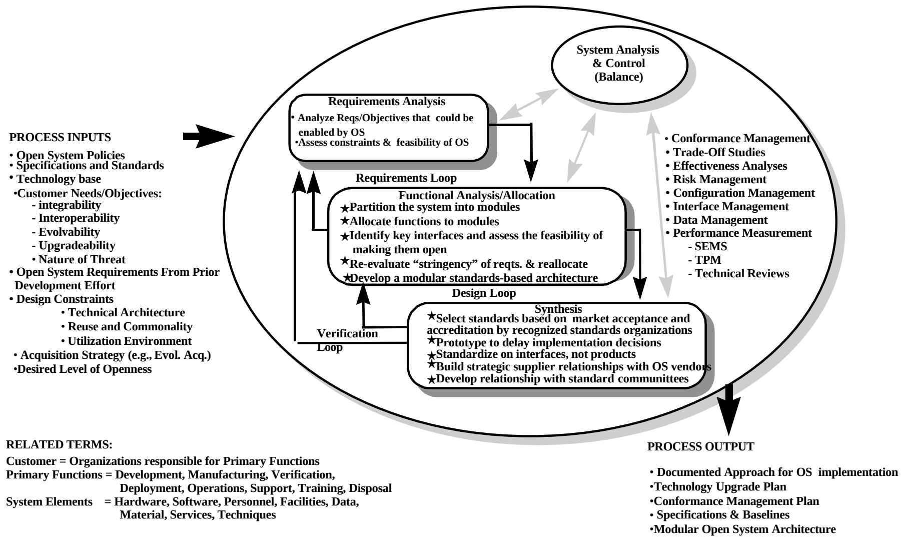


Figure 4: Open Systems Considerations in the SE Process

For further information contact the Open Systems Joint Task Force: phone (703) 602-0851; fax (703) 602-3560; or Email osjtf@acq.osd.mil. You can also visit the OS-JTF Homepage at http:\\www.acq.osd.mil/osjtf/

APPENDIX A

Excerpts of Open Systems Policy Language in the New DoD 5000 Series

Draft
April 2001

Prepared by
Open Systems Joint Task Force

Excerpts of Open Systems Policy Language in the New DoD 5000 Series

The open systems policy language has been greatly strengthened and improved in the latest rewrite of the DoD 5000 series. This document provides a complete listing of the open systems language contained in the new rewrite of the DoD 5000 series. The newly approved DoD Directive 5000.1 and the DOD Instruction 5000.2 now for the first time contain references to open systems. The open systems policy language contained in the new 5000.2-R are completely revised and have been expanded to other relevant sections/paragraphs in the Interim DoD 5000.2-R.

The excerpts of OS language contained in this document are organized based on their order of appearance at various paragraphs at each policy document. To facilitate the finding of the relevant language at each paragraph, the OS related language is highlighted in "bold."

I. Open Systems Related Policy at DoDD 5000.1 (approved October 23, 2000)

4.2. Rapid and Effective Transition From Science and Technology to Products.

4.2.1. The fundamental role of the DoD Science and Technology (S&T) program is to enable a technologically superior military force. The S&T program shall address user needs; maintain a broad-based program spanning all Defense-relevant sciences and technologies to anticipate future needs and those not being pursued by civil or commercial communities; preserve long-range research; and enable rapid transition from the S&T base to useful military products. ***S&T projects shall focus on*** *increasing the effectiveness of a capability while decreasing cost, increasing operational life, and* ***incrementally improving products through planned upgrades****. S&T executives shall encourage the use of initiatives, such as advanced technology demonstrations, designed to accelerate the transition from the S&T base to useful military products. Basic and applied research are the foundation for equipping tomorrow's user. To protect and ensure the success of the warfighter on the battlefield, the protection of dual-use and leading-edge military technologies begins during research and development in the laboratories (whether Government or commercial) and extends through the acquisition life-cycle. Thus it is imperative to maintain a strong technology base investment to develop options for the long term, beyond the threats, scenarios, and budgets that today's analysts can currently predict.*

4.2.3. Use of Commercial Products, Services, and Technologies. ***In response to user requirements, priority consideration shall always be given to the most cost-effective solution over the system's life cycle.*** *In general, decision-makers, users, and program managers shall first consider the procurement of commercially available products, services, and technologies, or the development of dual-use technologies, to satisfy user requirements, and shall work together to modify requirements, whenever feasible, to facilitate such procurements. Market research and analysis shall be conducted to determine the availability, suitability, operational supportability, interoperability, and* *ease of integration of existing commercial technologies and products and of non-developmental items prior to the commencement of a development effort.*

4.3. Rapid and Effective Transition from Acquisition To Deployment and Fielding

4.3.1. Evolutionary Acquisition. To ensure that the Defense acquisition system provides useful military capability to the operational user as rapidly as possible, evolutionary acquisition strategies shall be the preferred approach to satisfying operational needs. Evolutionary acquisition strategies define, develop, and produce/deploy an initial, militarily useful capability ("Block I") based on proven technology, time-phased requirements, projected threat assessments, and demonstrated manufacturing capabilities, and plan for subsequent development and production/deployment of increments beyond the initial capability over time (Blocks II, III, and beyond). The scope, performance capabilities, and timing of subsequent increments shall be based on continuous communications between the requirements, acquisition, intelligence, and budget communities. In planning evolutionary acquisition strategies, program managers shall strike an appropriate balance among key factors, including the urgency of the operational requirement; the maturity of critical technologies; and the interoperability, supportability, and affordability of alternative acquisition solutions. ***To facilitate evolutionary acquisition, program managers shall use appropriate enabling tools, including a modular open systems approach to ensure access to the latest technologies and products, and facilitate affordable and supportable modernization of fielded assets.*** *Sustainment strategies must evolve and be refined throughout the life cycle, particularly during development of subsequent blocks in an evolutionary strategy.*

4.3.4. Departmental Commitment to Production. ***Milestone decision authorities shall not commit the Department to the initiation of low-rate initial production*** *(or any production in the case of systems where low-rate initial production is not required)* ***of an acquisition program unless and until certain fundamental criteria have been considered and evaluated****. These criteria include, but are not necessarily limited to, demonstrated technology maturity; well-defined and understood user requirements that respond to identified threats; acceptable interoperability, affordability, and supportability; and a strong plan for rapid acquisition using evolutionary approaches as the preferred strategy,* ***open systems designs****, and effective competition.*

*4.2.4. Performance-Based Acquisition. In order to maximize competition, innovation, and interoperability, and to enable greater flexibility in capitalizing on commercial technologies to reduce costs, performance-based strategies for the acquisition of products and services shall be considered and used whenever practical. For products, this includes all new procurements and major modifications and upgrades, as well as the reprocurement of systems, subsystems, and spares that are procured beyond the initial production contract award. When using performance-based strategies****, contractual requirements shall be stated in performance terms, limiting the use of military specifications and standards to government-unique requirements only****. Configuration management decisions shall be based on factors that best support implementation of performance-based strategies throughout the product life cycle.*

4.3.3. Competition. Competition is critical for providing innovation, product quality, and affordability. All DoD Components shall acquire systems, subsystems, equipment, supplies and services in accordance with the statutory requirements for competition. Competition provides major incentives to industry and government organizations to reduce cost and increase quality. The Department must take all necessary actions to promote a competitive environment, including examination of alternative systems to meet stated mission needs; structuring Science and Technology investments and acquisition strategies to ***ensure the availability of competitive suppliers throughout a program's life*** *and for future programs; ensuring that prime contractors foster effective competition for major and critical products and technologies; and ensuring qualified international sources are permitted to compete. Acquisition, technology, and logistics decisions shall be made with full consideration of their impacts on a competitive industrial base, including not only the prime contractor level but also the subcontractor level.*

II. Open Systems Related Policy Language in the DoDI 5000.2 (approved on January 4, 2001)

4.6.1.2. Defense Acquisition System.

4.6.1.2.2. The Defense Acquisition System is a continuum composed of three activities with multiple paths into and out of each activity. Technologies are researched, developed, or procured in pre-system acquisition (science and technology and concept development and demonstration). Systems are developed, demonstrated, produced or procured, and deployed in systems acquisition. The outcome of systems acquisition is a system that represents a judicious balance of cost, schedule, and performance in response to the user's expressed need; that is interoperable with other systems (U.S., Coalition, and Allied systems, as specified in the operational requirements document); that uses proven technology, ***open systems design****, available manufacturing capabilities or services, and smart competition; that is affordable; and that is supportable. Once deployed, the system is supported throughout its operational life and eventual disposal in post-systems acquisition using prudent combinations of organic and contractor service providers, in accordance with statutes.*

4.7. The Defense Acquisition Management Framework.

4.7.2.1.1. *In the process of refining requirements, the user shall adhere to the following key concepts…*

- *4.7.2.1.1.2.* ***Avoid early commitments to system-specific solutions, including those that inhibit future insertion of new technology*** *and commercial or non-developmental items.*

- *4.7.2.1.1.5. **Evaluate how the desired performance requirements could reasonably be modified to facilitate the potential use of commercial or non-developmental items and components**.*

III. Open Systems Policy Language in the Interim DoD 5000.2-R (approved on January 4, 2001)

2.6.3: Integrated Digital Environment (IDE)

*…Contracts shall specify the required functionality and data standards**. The data formats of independent standards-setting organizations shall take precedence over all other formats.** The issue of data formats and transaction sets shall be independent of the method of access or delivery.*

2.6.6.2 Applying Best Practices

In tailoring an acquisition strategy, the PM shall address management constraints imposed on the contractor(s). PMs shall avoid imposing government-unique restrictions that significantly increase industry compliance costs or unnecessarily deter qualified contractors, including non-traditional defense firms from proposing. Examples of practices that support the implementation of these policies include IPPD; performance-based specifications; management goals; reporting and incentives**; an open systems approach that emphasizes commercially supported practices, products, performance specifications, and performance-based standards**; replacement of government-unique management and manufacturing systems with common, facility-wide systems; technology insertion for continuous affordability improvement throughout the product life cycle; realistic cost estimates and cost objectives; adequate competition among viable offerors; best value evaluation and award criteria; the use of past performance in source selection; results of software capability evaluations; government-industry partnerships, consistent with contract documents; and the use of pilot programs to explore innovative practices. The MDA shall review best practices at each decision point.

2.7.1 Open Systems

PMs shall apply the open systems approach as an integrated business and technical strategy upon defining user needs. PMs shall assess the feasibility of using widely-supported commercial interface standards in developing systems. The open systems approach shall be an integral part of the overall acquisition strategy to enable rapid acquisition with demonstrated technology, evolutionary and conventional development, interoperability, life-cycle supportability, and incremental system upgradability without major redesign during initial procurement and reprocurement of systems, subsystems, components, spares, and services, and during post-production support. It shall enable continued access to cutting edge technologies and products and prevent being locked in to proprietary technology. PMs shall document their approach for using open systems and include a summary of their approach as part of their overall acquisition strategy.

2.7.2 Interoperability

All acquired systems shall be interoperable with other U.S. and allied defense systems, as defined in the requirements and interoperability documents. The PM shall describe the treatment of interoperability requirements. If the acquisition strategy involves successive blocks satisfying time-phased requirements, this description shall address each block, as well as the transitions from block to block. This description shall ***identify enabling system engineering efforts such as network analysis, interface control efforts, open systems, data management, and standardization.*** *It shall also identify related requirements or constraints (e.g., treaties or international standardization agreements) that impact interoperability requirements (e.g., standards required by the DoD Joint Technical Architecture (JTA) or the systems, forces, units, etc. for which interoperability is at, or could be at issue), and any waivers or deviations that have been obtained or are anticipated being sought.*

2.8 Support Strategy

…The support strategy shall address all applicable support requirements to include, but not be limited to, the following elements: …long-term access to data to support …conversion of product configuration technical data to performance specifications when required for ***enabling technology insertion to enhance product affordability and prevent product obsolescence.***

2.8.1.1 Product Support Management Plan

As a minimum, the product support strategy shall address how the program will accomplish the following objectives:
.
.
Improve product affordability, system reliability, maintainability, and supportability via continuous, ***dedicated investment in technology refreshment through adoption of performance specifications, commercial standards, non-developmental items, and commercial-off-the-shelf items where feasible****, in both the initial acquisition design phase and in all subsequent modification and reprocurement actions.*

2.8.6. Life-Cycle Support Oversight

The support strategy shall address how the PM and other responsible organizations will maintain appropriate oversight of the fielded system. Oversight shall identify and properly address performance, readiness, ownership cost, and support issues, and shall ***include post deployment evaluation to support planning for assuring sustainment and implementing technology insertion, to continually improve product affordability****.*

2.9.1.2.2 Applying Competition to Evolutionary Acquisition

An evolutionary acquisition strategy must be based on time-phased requirements, consisting of an initial block of capability, and some number of subsequent blocks *necessary to provide the full capability required. Plans for competition must be tailored to the nature of each block, and the relationship of the successive blocks to each other. For example, if each block adds a discrete capability in a segregable package to a pre-established* ***modular open system architecture****, it may be possible and desirable to obtain full and open competition for each block. If each successive block enhances capability by building on its predecessor, such that it is necessary that the supplier of the first block also create the next block, then competition for the initial block may establish the sole source for subsequent blocks.*

2.9.1.3.2 Sub-Tier Competition

…Preparation of the acquisition strategy shall include an analysis of product and technology areas critical to meeting program needs. The acquisition strategy shall identify the potential industry sources to supply these needs. The acquisition strategy shall highlight areas of potential vertical integration (i.e., where potential prime contractors are also potential suppliers). Vertical integration may be detrimental to DoD interests if a firm employs internal capabilities without consideration of, or despite the superiority of, the capabilities of outside sources. The acquisition strategy shall describe the approaches the PM will use (e.g., ***requiring an open systems architecture****, investing in alternate technology or product solutions, breaking out a subsystem or component, etc.) to establish or maintain access to competitive suppliers for critical areas at the system, subsystem, and component levels.*

2.9.1.4.1 Market Research

The PM shall use market research as a primary means to determine the availability and suitability of commercial and non-developmental items, and ***the extent to which the interfaces*** *for these items* ***have broad market acceptance, standards-organization support, and stability.*** *Market research shall support the acquisition planning and decision process, supplying technical and business information about commercial technology and industrial capabilities.*

2.9.1.4.2 Commercial and Non-Develop-mental Items

The commercial market place widely accepts and supports open interface standards, set by recognized standards organizations. These standards support interoperability, portability, scalability, and technology insertion. When selecting commercial or non-developmental items, the PM shall prefer open interface standards and commercial item descriptions. If acquiring products with closed interfaces, the PM shall conduct a business case analysis to justify acceptance of the associated economic impacts on TOC and risks to technology insertion and maturation over the service life of the system.

2.9.1.4.3. Dual-Use Technologies and the Use of Commercial Plants

… ***System design shall facilitate the later insertion of leading-edge, dual-use technologies and components throughout the system life cycle.***

5.2 Systems Engineering

*…The systems engineering process shall….**Ensure the interoperability and integration of all operational, functional, and physical interfaces.** Ensure that system definition and design reflect the requirements for all system elements: hardware, software, facilities, people, and data; and…*
Requirement Analysis.*The PM shall work with the user to establish and refine operational and design requirements. Together, they shall determine appropriate operational performance objectives, within affordability constraints. Iterative requirements analyses shall accompany functional analysis/allocation to develop and refine system-level functional and performance requirements and external interfaces to **facilitate the design of open systems.***
*Functional Analysis/Allocation. Iterative functional analyses/allocations shall define successively lower-level functional and performance requirements, including functional interfaces and architecture **to achieve open systems** and facilitate the use of a performance-based business environment*. Functional and performance requirements shall track with higher-level requirements. System requirements shall be allocated and defined in sufficient detail to provide design and verification criteria to support the integrated system design. **System interface control requirements that are developed shall be documented.**
*Design Synthesis and Verification. Design synthesis translates functional and performance requirements into design solutions that include alternative people, product, and process concepts and solutions, and internal and external interfaces. **Design solutions shall be sufficiently detailed to verify that open system performance requirements have been met**…*
System Analysis and Control. System analysis and control activities shall provide the basis for evaluating and selecting alternatives, measuring progress, documenting design decisions, and enabling and managing block deliveries under an evolutionary acquisition strategy. They shall include the following…
.

- *A configuration management process to guide the system products, processes, and related documentation and facilitate the development of open systems...*
- *The **overall risk management effort shall include technology transition planning and shall establish transition criteria…. Interface controls to ensure all internal and external interface requirements changes are properly recorded and communicated to all affected configuration items.***

5.2.5 Open Systems Design

PMs shall use a modular, standards-based architecture in the design of systems. They shall identify key interfaces and define the system level (system-of-systems, system, subsystem, or component) at and above which these interfaces use various types of standards. Preference shall be given to the use of open interface standards first, then de facto interface standards, and finally government and proprietary interface standards. PMs shall report on their progress using open standards for key interfaces at both Milestones B and C.
PMs shall use an open systems approach to achieve the following objectives:

- ***To adapt to evolving requirements and threats;***
- ***To accelerate transition from science and technology into acquisition and deployment;***
- ***To enhance modularity and facilitate systems integration;***
- ***To leverage commercial investment in new technologies and products;***
- ***To reduce the development cycle time and total life-cycle cost;***

- ***To ensure the system is fully interoperable with all systems with which it must interface, without major modification of existing components;***
- ***To achieve commonality and reuse of components among systems;***
- ***To provide users the ability to quickly and affordably interconnect and assemble existing platforms, systems, subsystems, and components as needed;***
- ***To maintain continued access to cutting edge technologies and products from multiple suppliers during initial procurement, reprocurement, and post-production support;***
- ***To mitigate the risks associated with technology obsolescence, being locked into proprietary technology, and reliance on a single source of supply over the life of a system;***
- ***To conduct business case analyses to justify decisions to enhance life-cycle supportability and continuously improve product affordability through technology insertion during initial procurement, reprocurement, and post-production support; and***
- ***To facilitate modular contracting.***

5.2.6. Software Management

The PM shall manage and engineer software-intensive systems using best processes and practices known to reduce cost, schedule, and performance risks.

5.2.6. General

The PM shall base software systems design and development on systems engineering principles, to include the following:
Develop architectural based software systems that support open system concepts; exploit COTS computer systems products; and allow incremental improvements based on modular, reusable, extensible software…

5.2.7 COTS Considerations

The use of commercial items often requires changes in the way systems are conceived, acquired, and sustained, to include…

- *The PM shall plan for robust evaluations to assist in fully identifying commercial capabilities, to choose between alternate architectures and designs, to determine whether new releases continue to meet requirements, and to* ***ensure that the commercial items function as expected when linked to other system components.*** *In addition, evaluation provides the critical source of information about the* ***tradeoffs that must be made between the capabilities of the system to be fielded and the system architecture and design that makes best use of commercial capabilities.*** *Evaluating commercial items requires a focus on mission accomplishment, and matching the commercial item to system requirements.*
- *The PM shall engineer the system architecture and establish a rigorous change management process for life-cycle support. Systems that integrate multiple commercial items require extensive engineering to* ***facilitate the insertion of planned new commercial technology****. This is not a "one time" activity because unanticipated changes may drive reconsideration of engineering decisions throughout the life of the program.* ***Failure to address changes in commercial items and the marketplace will potentially result in a system that cannot be maintained as vendors drop support for obsolete commercial items.***

5.3.2 Performance Specifications

*The Department shall use performance specifications (i.e., DoD performance specifications, commercial item descriptions, **and performance-based non-government standards**) when purchasing new systems, major modifications, upgrades to current systems, and commercial and non-developmental items for programs in all acquisition categories… The following additional policy shall apply…**If no acceptable, non-governmental standards exist, or if using performance specifications or non-government standards is not cost effective, not practical, or does not meet the users' needs, over a product's life cycle, the Department may define an exact design solution with military specifications and standards, as last resort, with MDA-approved waiver.***

APPENDIX B

ADDRESSING OPEN SYSTEMS IN A REQUEST FOR PROPOSAL

Draft

April 2001

Prepared by

Open Systems Joint Task Force

I. Introduction

This document contains examples of language suitable for use in an RFP and supporting documents to facilitate the application of an open systems (OS) approach by offerors proposing to develop new systems or modify existing legacy systems.

The language examples are intended to be stand-alone generic statements that provide effective ways of addressing open systems in a particular context. Each example is not applicable to every case – you must select the examples that are useful in your particular situation. The examples should be tailored, as appropriate, to meet specific program requirements.

Finally, the examples provided do not address every possible need. Do not view what is provided as a comprehensive list that limits what can be said in a RFP, but rather as a starting point for considering the best way to make the points you need to make.

II. Examples of Open System Language

A. Executive Summary or Cover Letter Language

Many contracting activities issue RFPs with a cover letter or executive summary that tells potential offerors about the requirement that needs to be satisfied and what matters most to the government. Identifying open systems as a key interest or goal, in the cover letter or executive summary, emphasizes to potential offerors that the open systems approach is important to the government. Here are examples of open systems language that may be appropriate in a cover letter or executive summary:

- *“Provide for a system that allows for interoperability and cost effective incremental upgrade over the entire life cycle of the system without dependence upon a single source.*
- *Deploy a system characterized by life-long viability, a standard-based and robust architecture, and capability to insert new technology based on the cycle rates of the ensuing technologies in system components.*
- *Build a system that can be improved incrementally without redesign of the entire system or large portions thereof."*

B. Statements of Objectives (SOO) Language

A SOO is an excellent tool for conveying to the offerors the main objectives of the acquisition. As offerors prepare their proposals they can concentrate on ensuring that they meet or exceed all of the objectives stated in the SOO. If a SOO is being used and performance or operational requirements necessitate open systems application, the following examples of objectives may be used.

The Offerors shall use an open systems approach to:

1. *Facilitate development of a modular architecture and allow for affordable intraoperability*
2. *ensure that the system design is sufficiently flexible and robust to accommodate changing technology and requirements*
3. *facilitate integration and use of commercial products from multiple sources both in the initial design and in future enhancements,*
4. *enable technology insertion as currently available commercial products mature and new commercial products become available in the future,*
5. *allow for affordable support,*
6. *allow continued access to technologies and products supported by many suppliers (a broad industrial base which does not restrict available sources to the detriment of competition)*

For systems with commercial products that tend to evolve and improve with time:

"Sy*stem design enables technology insertion as currently available commercial products mature and new commercial products become available in the future."*

or

"Enable incremental system improvements through upgrades of individual hardware or software modules with newer modular components without redesign of entire systems or large portions thereof."

If technology obsolescence is a risk that must be managed:

"Mitigate the risks associated with technology obsolescence, being locked into proprietary technology, and reliance on a single source of supply over the life of the system."

An overall objective to take advantage of the benefits of an Open System Approach (OSA):

"Build the system based on modular hardware and software design, choosing commercially supported specifications and standards for selected interfaces (external, internal, functional, and physical) products, practices, and tools."

C. Requirements Document Language

The offerors are more likely to use open system as a suitable business and technical strategy for building systems when open systems attributes are embedded in performance/operational requirements. The following open systems language may be used in a requirements documents such as the System Requirements Document (SRD), System Specification, Technical Requirements Document (TRD), Performance Work Statement (PWS), Statement of Work (SOW), etc:

"The contractor shall use an open-system approach to evaluate the appropriateness of implementing an open system design strategy for building systems. A primary consideration in selection of equipment to meet the design functionality shall be the impact to the overall open systems architecture. An open systems approach and analysis of long term supportability, interoperability, and growth for future modifications shall be major factors in the contractor's final selection of equipment and integration approach. All the systems components shall facilitate future upgrades and permit incremental technology insertion to allow for incorporation of additional or higher performance elements with minimal impact on the existing systems.

The architectural approach shall provide a viable technology insertion methodology and refresh strategy that supports a long-term open systems application approach and is responsive to changes driven by mission requirements and new technologies.

The contractor shall develop a detailed open systems design and integration that includes but is not limited to the following aspects: interoperability, intra-operability, upgradeability, transportability, software standards, interface standards, long term supportability, sources of supply and/or repair, business strategies, and other entities that affect open systems application.

For those portions of hardware, firmware, or software that are driven to proprietary and/or closed system architectures by mission specific requirements, a hardware/firmware/software partitioning or other design features to mitigate the system level impacts shall be provided

The offeror shall provide an orderly, planned approach to address migration of proprietary or closed system equipment or interfaces to an open system design when technological advances are available.

The offerors' design and integration shall preclude long term dependence on closed or proprietary interface standards or architectures with impacts to intra-operability and upgradeability. Secure or classified data systems shall also conform to the open systems design approach as much as practical. The design shall provide sufficient growth and open interface standards to allow future weapon system specific requirements to be integrated without large-scale redesign of the system."

D. Section L Language

Section L includes instructions for the offeror to include information evaluators will need to assess the open systems approach against the evaluation criteria. The language examples that follow are intended to be stand-alone examples of "Instructions for Proposal Preparation" that might serve this purpose. Each example is not applicable to every case – you should select the examples that are useful in your particular situation

The proposal shall describe how the Offeror's open systems approach will cause the Offeror to (1) choose commercially supported specifications and standards for selected system interfaces (external, internal, functional, and physical), products, practices, and tools, and (2) build open *system architectures as the primary foundation in developing the proposed system. In describing the open systems approach, the proposal shall include:*

- *plans for integrating the systems internally and with external systems."*
- *identification of the means for ensuring conformance to widely used consensus standards (i.e., open standards) and profiles throughout the development process, and an explanation of how the open systems approach supports benefits such as portability, interoperability, technology insertion, vendor independence, reusability, scalability, and commercial product based maintainability."*
- *a description of how the technical approach ensures having access to mature as well as the latest technologies by establishing a robust, modular, and evolving architecture based on widely used consensus standards*
- *a description of how the design concept supports an open systems approach*
- *a description of the approach for maintaining the currency of technology (e.g., through COTS insertion, technology refresh strategies, and other appropriate means).*
- *Identification of processes for:*
    1. *Specifying the lowest level (e.g., subsystem or component) at and below which they intend to control and define interfaces by proprietary standards and the impact of that upon their proposed logistics approach.*
    2. *Evaluating open systems baseline standards, defining and updating profiles, evaluating and justifying new and contractor/vendor unique profiles.*
    3. *Validating implementation conformance to selected profiles.*
    4. *Managing application conformance to selected profiles.*
    5. *Training in use of profiles.*

"The offerors shall specify how they plan to use the open systems strategy as an enabler to achieve the following objectives:

- *adapt to evolving requirements and threats;*
- *accelerate transition from science and technology into acquisition and deployment;*
- *enhance modularity and facilitate systems integration;*
- *leverage commercial investment in new technologies and products;*
- *reduce the development cycle time and total life-cycle cost;*
- *achieve commonality and reuse of components within a system (if commonality is a requirement);*
- *maintain continued access to cutting edge technologies and products from multiple suppliers;*
- *mitigate the risks associated with technology obsolescence, being locked into*

proprietary technology, and reliance on a single source of supply over the life of a system;

- *enhance life-cycle supportability.*

When the RFP is requesting proposals that will involve the modernization of legacy systems, one or more of the following language examples may be useful.

- *"The offeror shall clearly demonstrate the open systems design philosophy in all aspects of the system upgrade. In addressing the requirements specified, the proposal must demonstrate how the open systems design philosophy applies, and the effect it will have on the system upgrade." The proposal shall also provide documentation to support the rationale for a decision to integrate a proprietary or closed system hardware and/or software functions within the proposed system.*
- *The proposal shall describe the orderly planned process to address migration of proprietary or closed system equipment or interfaces to an open system design when technological advances are available or when operational capability is upgraded. The proprietary or closed systems implementation shall also be reflected in the offeror's system level life cycle cost estimates.*
- *The design approach shall either mitigate or partition the proprietary or closed systems implementation to avoid outyear supportability issues and diminishing manufacturing sources and sources of repair."*

E. Section M Language

Listed below are discriminators you may use as part of the evaluation criteria calling for application of an open system strategy:

Does the offeror's proposal provide the User with the ability to:

1. *quickly interconnect and assemble existing forces, systems, subsystems, and components*
2. *interchange and use information, services and/or physical items among components within a system,*
3. *interchange and use information, services and/or physical items among systems within a platform, domain, or a DoD Component,*
4. *support the common use of components across various product lines,*
5. *transfer a system, component, or data, from one hardware or software environment to another, and*
6. *adapt hardware or software to accommodate changing work loads.*

The following list of language should be selected to correspond with specific requirements or instructions provided to the offerors in prior sections of the RFP.

- *Does the offeror's information technology architecture support interface requirements analysis, evolution of system capabilities, and selection of open systems-based software and hardware?*
- *How consistent is the offeror's overall sustainment strategy and execution approach with the open systems approach?*
- *How well the proposal demonstrates that the design approach, plans for technology insertion, and sustainment strategy are consistent with the open systems requirements/objectives in Section C."*
- *How well does the offeror's system design satisfy the requirement for a modular design approach that uses consensus standards adopted by recognized standards organizations and/or widely-used commercial standards for key interfaces within the system?*
- *Is the offeror's design process or systems engineering approach capable of enabling the following open systems objectives:*

    enabling interoperability and the ability to integrate new capabilities without redesign of entire systems or large portions thereof

    enabling adaptation to evolving threats and technologies by managing to the natural upgrade cycles of technologies used in a system

    achieving life-long supportability and lower total cost of ownership via continued access to multiple sources of supplies and services

    allowing incremental system improvements through upgrades of individual hardware or software modules with newer modular components

- *Does the offerors' design approach achieve identified open system benefits such as higher performance, life-long supportability, reduced total ownership costs, lower risks associated with technological obsolescence and dependency on a single source of supply, and other requirements such as integrability, scalability, and portability?*
- *Does the offeror have a plan to manage the impact of changing requirements and evolving technology on system's ability to continue to satisfy requirements over time?*
- *Does the offeror's design approach propose to define interfaces in sufficient completeness and detail such that selected element(s) can be replaced and/or modified in a competitive environment with minimal modifications to other system elements while maintaining equal or improved system performance and capability?*
- *Does the offeror's approach comply with open systems objectives/requirements such as continued access to multiple suppliers and improved performance through affordable modernization?*

- *Does the offeror’s test and evaluation planning contain means for testing the conformance to open standards?*
- *Does the offeror’s approach contain capabilities to easily and quickly update, revise, and change the system as threats or technologies evolve?*
- *Does the offeror’s criteria for production, deployment, and sustainment compatible with the open system policy requirements contained in the DOD 5000 regulation series?*
- *Does the offeror's technical management approach include explicit engineering analysis and trade studies to justify deviations from using an open systems approach?*

These are just a few examples of language that can be used to formulate an open systems approach to meeting the business and technical objectives of your program. These statements can be documented in your acquisition planning process and throughout all of your program and contractual documentation. Once you have decided on how to apply an open systems approach to your program you will be able to lay a clear trail that starts with acquisition planning and can be traced from your objectives to requirements to evaluation criteria and throughout execution of the program.

APPENDIX C

Terms and Definitions

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Prepared by
Open Systems Joint Task Force

Appendix C

Terms and Definitions

Note: Unless stated otherwise, these terms of reference are defined by the Open Systems Joint Task Force (OSJTF).

Architecture

The organizational structure of a system or component, their relationships, and the principles and guidelines governing their design and evolution over time. *(IEEE 610.12)*

Commercial Item

The CI definition can be found in *Federal Acquisition Regulation (FAR) Subchapter A General, Part 2, 2.101 Definitions at http://www.arnet.gov/far/*

Component

A product that is not subject to decomposition from the perspective of a specific application. (ISO 10303-1)

Closed Interfaces

Privately controlled system/subsystem boundary descriptions that are not disclosed to the public or are unique to a single supplier.

De facto standard

A standard that is widely accepted and used but that lacks formal approval by a recognized standards organization. *(FED-STD-1037C)*

Design Architecture

An arrangement of design elements that provides the design solution for a product or life cycle process intended to satisfy the functional architecture and the requirements baseline. *(IEEE 1220)*

Domain

A grouping of related items within a certain area of interest.

End Product

The portion of a system that performs the operational functions and is delivered to an acquirer. *(IEEE 1220)*

Functional Architecture

An arrangement of functions and their subfunctions and interfaces (internal and external) that defines the execution sequencing, conditions for control or data flow, and the performance requirements to satisfy the requirements baseline. *(IEEE 1220)*

Interface

The functional and physical characteristics required to exist at a common boundary or connection between systems or items. *(DoD 4120.214-M)*

Interface Standard

A standard that specifies the physical, functional, and operational relationships between various elements (hardware and software), to permit interchangeability, interconnection, compatibility and/or communications.

Interoperability

The ability of systems, units, or forces to provide data, information, materiel, and services to and accept the same from other systems, units, or forces, and to use the data, information, materiel, and services so exchanged to enable them to operate effectively together. *(DoDD 5000.1)*

Intraoperability

The ability to (1) interchange and use information, services and/or physical items among components within a system (platform, program or domain) and (2) support the common use of components across various product lines.

Key Interface

An interface for which the preferred implementation uses an open standard to design the system for affordable change and enhance commonality and reuse of components.

Modular Design

Characterized by the following:

> Functionally partitioned into discrete scalable, reusable modules consisting of isolated, self-contained functional elements
>
> Rigorous use of disciplined definition of modular interfaces, to include object oriented descriptions of module functionality
>
> Designed for ease of change to achieve technology transparency and, to the extent possible, makes use of commonly used industry standards for key interfaces

Module

An independently operable unit that is a part of the total structure. (Merriam-Webster)

Open Standards

Standards that are widely used, consensus based, published and maintained by recognized industry standards organizations.

Open Systems Approach

An integrated business and technical strategy that employs a modular design and, where appropriate, defines key interfaces using widely supported, consensus-based standards that are published and maintained by a recognized industry standards organization.

Open Architecture

An architecture that employs open standards for key interfaces within a system.

Proprietary Standard

A standard that is exclusively owned by an individual or organization, the use of which generally would require a license and/or fee.

Reference Model

A structure which allows the modules and interfaces of a system to be described in a consistent manner.

Stakeholder

An enterprise, organization, or individual having an interest or a stake in the outcome of the engineering of a system. *(EIA-632, Annex A)*

Standard

A document that establishes engineering and technical requirements for products, processes, procedures, practices, and methods that have been decreed by authority or adopted by consensus. *(EIA-632, Annex A)*

Subsystem

A grouping of items that perform a set of functions within a particular end product. *(EIA-632, Annex A)*

System

A combination of two or more interrelated pieces of equipment (or sets) arranged in a functional package to perform an operational function or to satisfy a requirement. *(Defense Acquisition Glossary of Terms, Jan 2001)*

System Architecture

The composite of the design architectures for products and their life cycle processes. *(IEEE 1220-1998)*

Weapon System

An item or set of items that can be used directly by warfighters to carry out combat or combat support missions to include tactical communication systems. *(DoDI 5000.2)*